N90-16692

1989 NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM

JOHN F. KENNEDY SPACE CENTER
UNIVERSITY OF CENTRAL FLORIDA

ANALYSIS OF THE 60-Hz POWER SYSTEM AT KSC - THE ORSINO SUBSTATION

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DATE:	August 18, 1989
CONTRACT NUMBER:	University of Central Florida NASA-NGT-60002 Supplement: 2

ACKNOWLEDGEMENT

I am very grateful to the U.C.F. Coordinators of ASEE/NASA Fellowship Program and to the NASA KSC authorities for the opportunity to participate in what has been a rewarding experience this summer. Specifically, I wish to express my appreciation to Dr. Ray Hosler for making the summer program as much fun as it was a challenge. Thanks, Ray, for all the refreshing extra-morale activities. Ms Kari Baird also deserves many thanks for her willingness to help every time.

I would also like to express my indebtedness to my NASA colleague, Mr. Julian King, for his friendliness and assistance during this Study. Julian played a good host and answered all my questions - giving direct contacts to answer the very few questions he could not. He was very resourceful and a patient teacher. Mr. Steven C. Milton, a U.C.F. electrical engineering student who worked with me, deserves a mention. Steve produced all the graphics and did an 'A' job at it.

Many thanks also to the EG&G engineers who I interacted with during the Study. Finally, thanks to Mrs. Imogene Smith for typing the report.

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ABSTRACT

An analysis of the Orsino Substation, a component (50%) of the 60-Hertz electric power system at the Kennedy Space Center, is presented. This report contains separate single-line diagrams of the sixteen feeder circuits to permit easy access to information on the individual feeders for future planning. The load condition of each feeder and load break switch are presented and a heuristic reliability analysis of the system is performed. This report contains information about the system organized in a useful fashion for decision making purposes. The beauty of it is in the simplified manner by which information about the system can be obtained.

SUMMARY

The various feeder networks comprising the Orsino Substation are decoupled and presented in easy-to-read diagrams without any loss of information. The connected loads to each load break switch (LBS) are computed to determine the exact load conditions of each LBS and feeder. These data are compared to the demands, a useful information for power coordination and growth planning. The load connected to each primary transformer is also compared to the demand and to the size of the transformer. The Study shows that, though the system is still very healthy, a systematic planning should be instituted. Hitherto, load has been added arbitrarily or perhaps based on geographic convenience. This cannot continue indefinitely if an optimal lifetime and performance of the system is to be expected.

I. INTRODUCTION

1.1 Purpose

The 60-Hertz electric power system at the Kennedy Space Center (KSC) is described in [1] the GP-900 document. This document, the authors point out, is for the benefit of present and potential users of the power system to help them determine whether their requirements can be met adequately or not. It, therefore, identifies the facilities and the types of power available to them in pursuant to the objectives of the system.

The focus of this paper is different. It is for the attention of the NASA/KSC staff whose functions might include a managerial role in the system expansion planning and reliability evaluation. This paper is also directed toward the system planners and operators and those responsible for system reliability. Much of the information contained in this paper is derived from [2] - the system one-line diagrams document 79K17429. The purpose of this paper is to provide an easy reference and guideline to the NASA staff overseeing system planning when making a decision on adding (or deleting) components to the system. This document is also invaluable for a quick appraisal of the system's load conditions and reliability status. There is a tremendous reduction in effort and time in obtaining information from this paper as compared to doing the same from the one-line diagram document 79K17429.

1.2 Scope and Methodology

This report describes and evaluates only one of the two substations comprising the 60-Hertz electric power distribution system at KSC - the Orsino Substation. This Substation is decoupled, and the Study is done on a feeder-by-feeder basis. A one-line diagram of each feeder in normal configuration is drawn. It is, hence, easy to describe and evaluate the electrical status of the isolated feeder. Both the diagrams and the tables showing the load conditions and a somewhat heuristic assessment of the reliability at various load points are useful tools for decision making.

1.3 Assumptions

The protective devices such as fuses, reclosers, and circuit breakers are assumed to be perfect and known. They are thus omitted in the diagrams (for the most part) so as to enhance clarity and for easy perusal which is a chief objective of this paper.

The feeder diagrams depict the normal configuration status of the individual feeders, i.e., in drawing the one-line diagram of a given feeder, the entire system is assumed healthy.

The load connected to a substation (transformer) cannot exceed the KVA rating of the substation.

The primary voltage of all the substations is understood to be 13.2 KV, and the secondary voltages of the substations are irrelevant to the assessment of the reliability conditions of a load break switch (LBS). Thus, these pieces of information are omitted in both diagrams and tables. Furthermore, they are easily assessible and readily available from other existing documents.

II ORSINO SUBSTATION BRIEF DESCRIPTION

2.1 General

The Orsino substation generally referred to as the industrial area substation is described in the GP-900 document. As is the general intent of that document the description is with regards to the facilities served by the substations rather than its configuration. To determine the margin between available power and demand, it is important to know what feeders are connected to a given transformer in the distribution station. The description that follows is given in the order depicted in the systems one-line diagram, document 79K17429. This description is also an attempt to simplify the diagram.

2.2 Substation Transformers and Assigned Feeders

The six individual transformers in the Orsino distribution station supply power to the following feeders under normal configuration.

T6: 10000/12 500 KVA, 3-0, 115 KV/13-2 KV

Supplies feeder 206

T5: 1000/12 500 KVA, 3-0, 115 KV/13-2 KV

Supplies feeders 211, 207, and 201

T4: 1000/12 500 KVA, 3-0, 115 KV/13-2 KV

Supplies feeders 210, and 202//203

T3: 10000/12 500 KVA, 3-0, 115 KV/13-2 KV

Supplies feeders 208, 209, 212 and 204//205

T2+T1: 5000 KVA, 3-0, 115 KV/13-2 KV

Supply feeders 101, 102, and 103.

III METHOD OF INVESTIGATION AND DESCRIPTION OF DATA

3.1 Feeder Single Line Diagrams

The preliminary drafts of the separate one-line diagrams of the individual feeders were drawn from the system one-line diagram - 79K17429 document. This was done by tracing the loads of each feeder from the distribution station (M6-996) through the load break switches connected to it to the various loads and interconnection points with other feeders. To determine the load supplied by a feeder at normal configuration coordination board diagram was visited. Here the normally open (N.O) and normally close (N.C.) switches are shown. Using this information and from discussions with the power coordinators the final draft of feeder one-line diagrams were drawn.

This report arranges the feeder diagrams in the same order (from left to right) they are found in order documents and computer data base for the system. However, the present and normal configuration shows some redundant feeders (as two feeders in parallel) such as feeders 202//203, 103//212, and 204//205. In these cases only one diagram is shown for both feeders and which ever feeder between the two that is at a higher position in the arrangement (to the left of the other in the system one-line diagram) determines its position in this document, e.g. feeder 103//212 is figure number 9 because FDR 212 is the nineth item in the feeder data base though FDR 103 is the thirteenth item.

The following symbols and notations are represented in the diagrams.

-----------o------------	Normally open (N.O)
<u>#</u>	Load Break switch member (LBS#)
(#)	Connector line number
#	Rated Load in KVA (Size of Substation)

The numbers shown in this report correspond to those assigned to the various components in other existing documents on the system.

3.2 The Connected Load Data

Table 1 is a tabular description of the load conditions of the various load break switches connected to each feeder. These are presented on a feeder by feeder bases in the same order as the single-line diagrams. For a given feeder, the load break switches (LBS) are listed from bottom of feeder up to the distribution station transformers supplying power to the feeder.

The second column of table 1 shows the feeders connected to the LBS. If this column shows more than one entry for a LBS, the first entry is the main supply feeder (the feeder under discussion) while the others are redundancies. The redundancies for a LBS are shown together with the LBS from which they are connected.

The third column of table 1 lists the LBS numbers to which the LBS under consideration is connected. The first of those LBS numbers is usually the bus from which the LBS under consideration draws power.

Column 4 of table 1 shows the load connected to the LBS. This is the sum total of the rated KVA of the transformers connected to the LBS either directly or through other LBS's. It will be observed that this figure increases as one goes up the ladder (down the column). Since some LBS's constitute loads for the preceding LBS. There may be more than one entry in this column. This happens when an LBS shares load with another LBS. The shared loads are denoted by superscript numbers which are explained below.

Explanation of superscripts:

1. The 1900 KVA Load is shared with LBS # 51 on feeder 201

2. The 2500 KVA Load is shared with LBS # 34 on feeder 201

3. The 325 KVA Load is shared with LBS # 23 on feeder 208

4. The 2500 KVA Load is shared with LBS # 59

5. The 1900 KVA Load is shared with LBS # 36 on feeder 211

6. The 150 KVA Load at LBS # 59 is shared with feeder 208 Via LBS #23

7. The 325 KVA Load is shared with LBS # 59

Column 5 of table 1 shows the redundancy ties of the LBS. The term "Failure" is used to indicate disconnection. It might be intentional - during planned switching - for instance, or unintentional as in the case of a fault. In any event the entries on this column show the additional load that will be connected to the LBS if a failure occurred above a designated LBS on designated feeder but no higher than the next LBS. Only single failures are considered, i.e. if more than one redundant line is connected to the would-be failed LBS, that case will not be considered. Simply, only inevitably added loads in the event of a failure are listed.

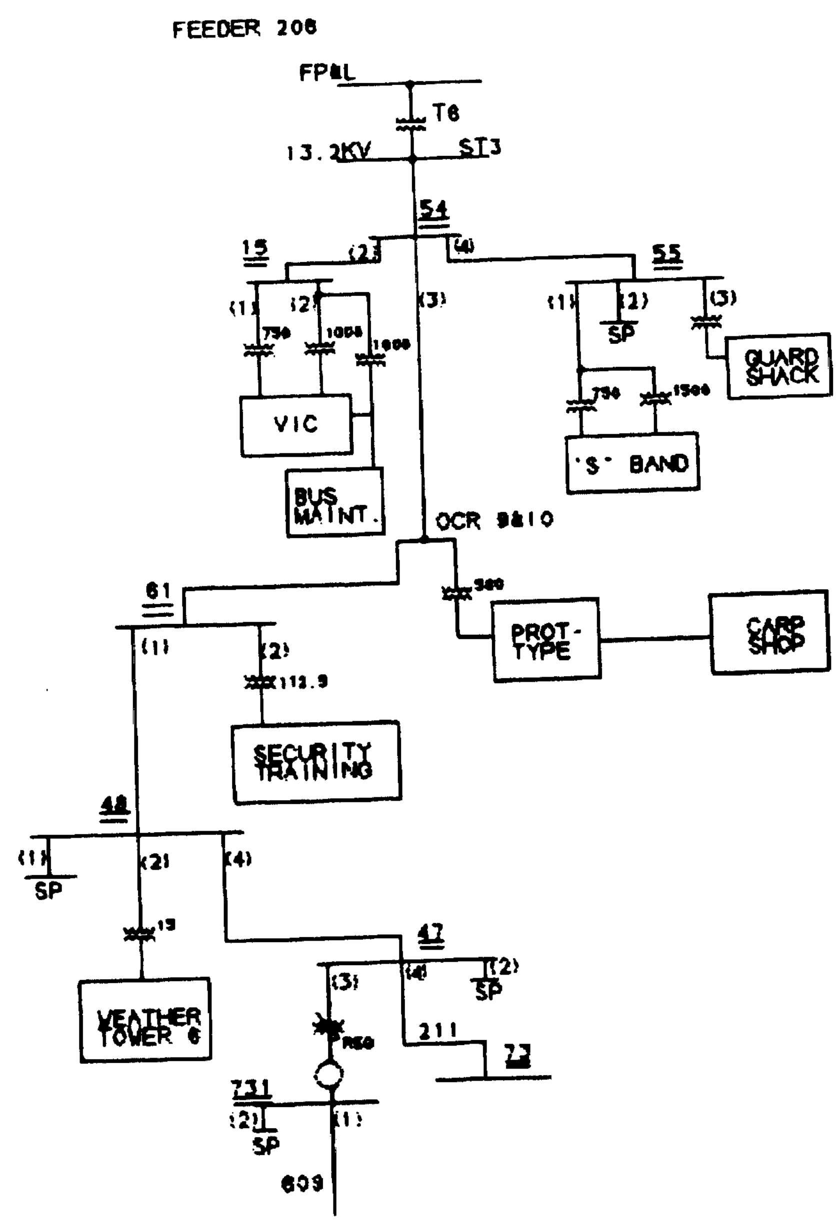

FEEDER 208
FP&L
T6
13.2KV
ST3
54
15
55
(1)
(2)
(3)
(4)
750
1000
VIC
BUS MAINT.
SP
GUARD SHACK
1500
'S' BAND
OCR 9&10
500
PROT-TYPE
CARP SHOP
61
112.9
SECURITY TRAINING
48
13
WEATHER TOWER 6
47
REG
211
72
731
609

FIGURE 1

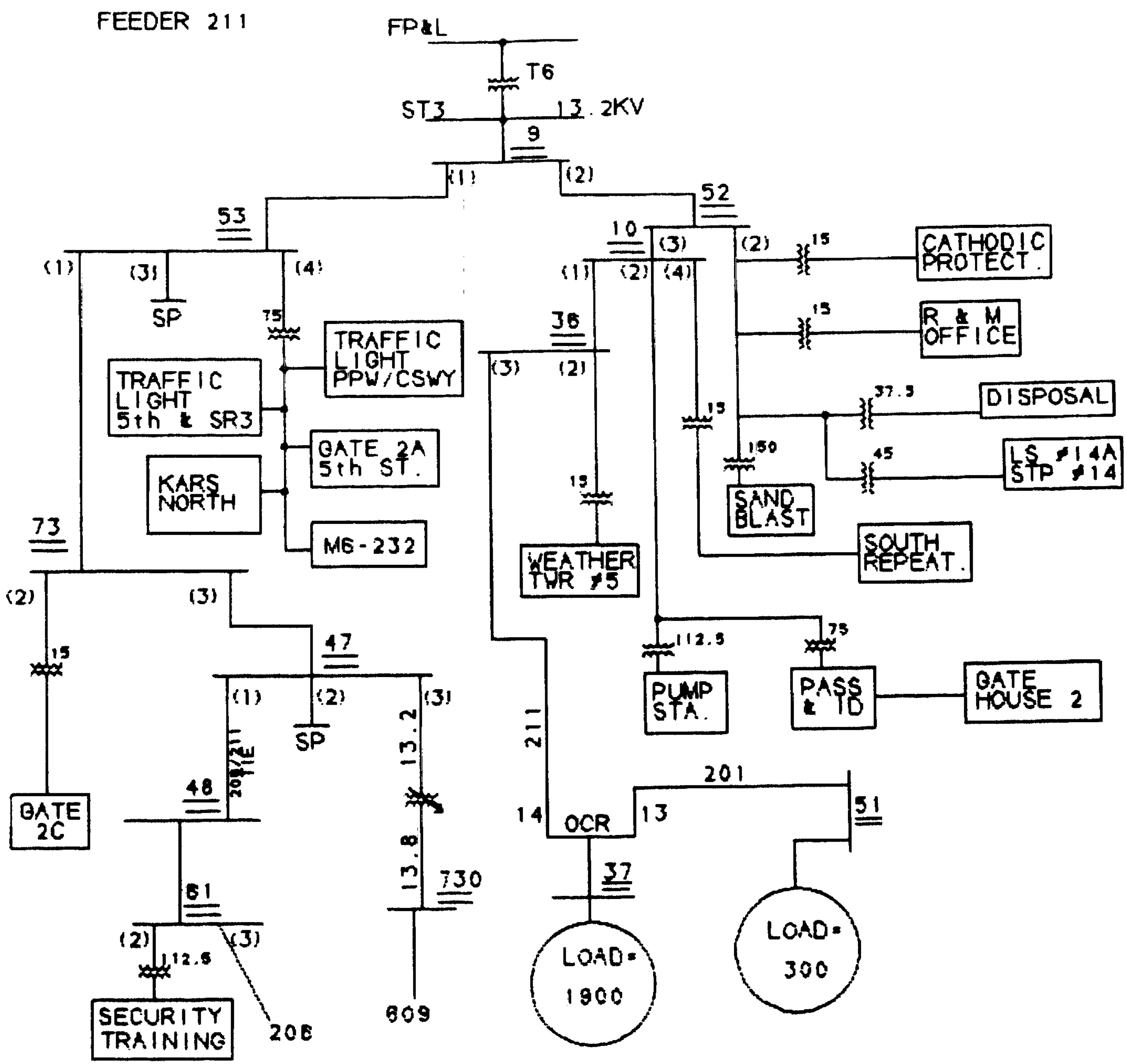

FEEDER 211
FP&L
T6
ST3
13.2KV
9
(1)
(2)
53
52
10
(1)
(3)
SP
(4)
75
TRAFFIC LIGHT PPW/CSWY
TRAFFIC LIGHT 5th & SR3
GATE 2A 5th ST.
KARS NORTH
M6-232
73
(2)
15
GATE 2C
(3)
47
(1)
(2)
SP
(3)
48
61
(2)
112.5
SECURITY TRAINING
(3)
208
13.2
13.8
730
609
36
(3)
(2)
15
WEATHER TWR #5
211
14
OCR
37
LOAD= 1900
13
201
51
LOAD= 300
(1)
(2)
(4)
(3)
(2)
15
CATHODIC PROTECT.
15
R & M OFFICE
37.5
DISPOSAL
45
LS #14A STP #14
150
SAND BLAST
15
SOUTH REPEAT.
112.5
PUMP STA.
75
PASS & ID
GATE HOUSE 2

FIGURE 2

FEEDER 207

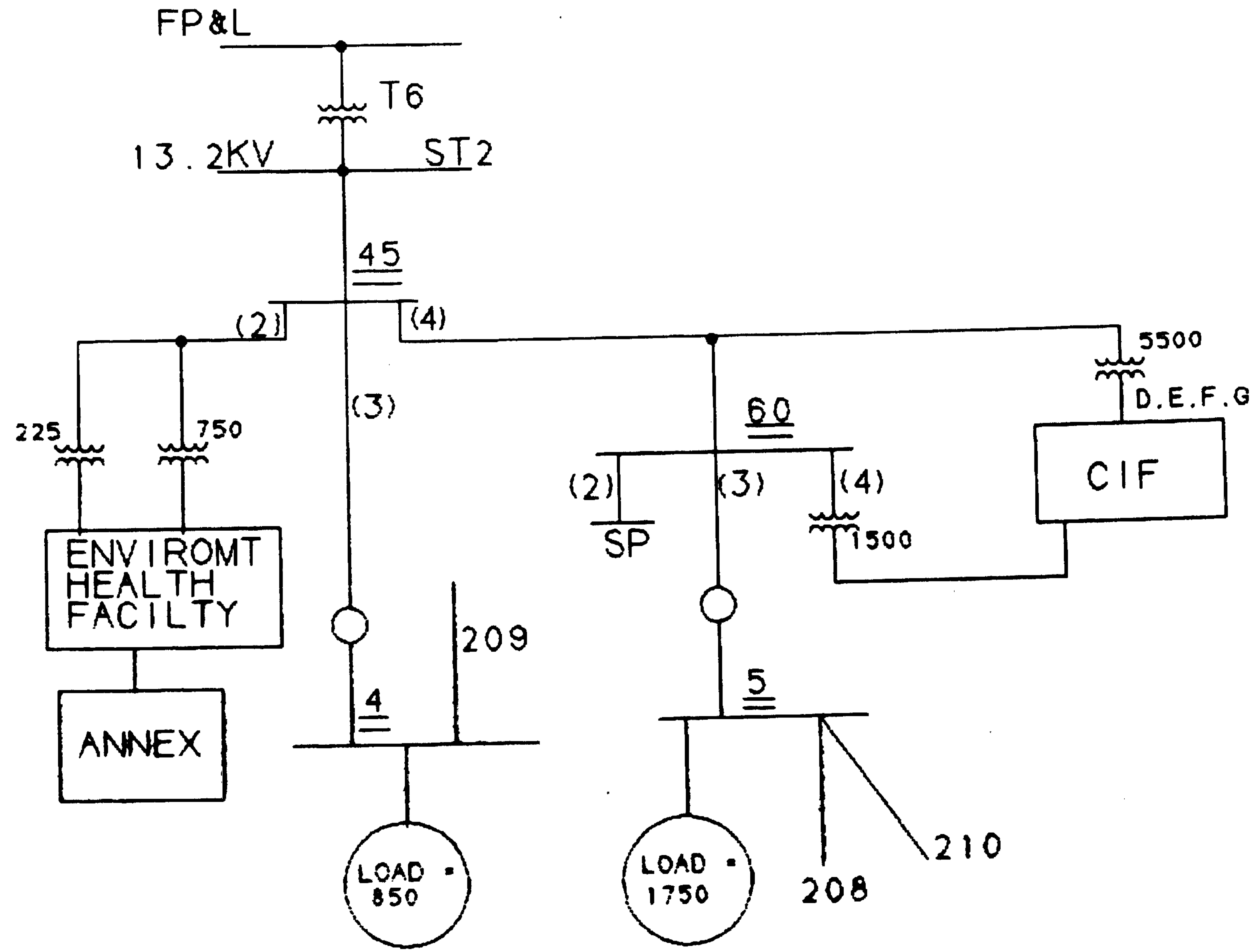


FIGURE 3

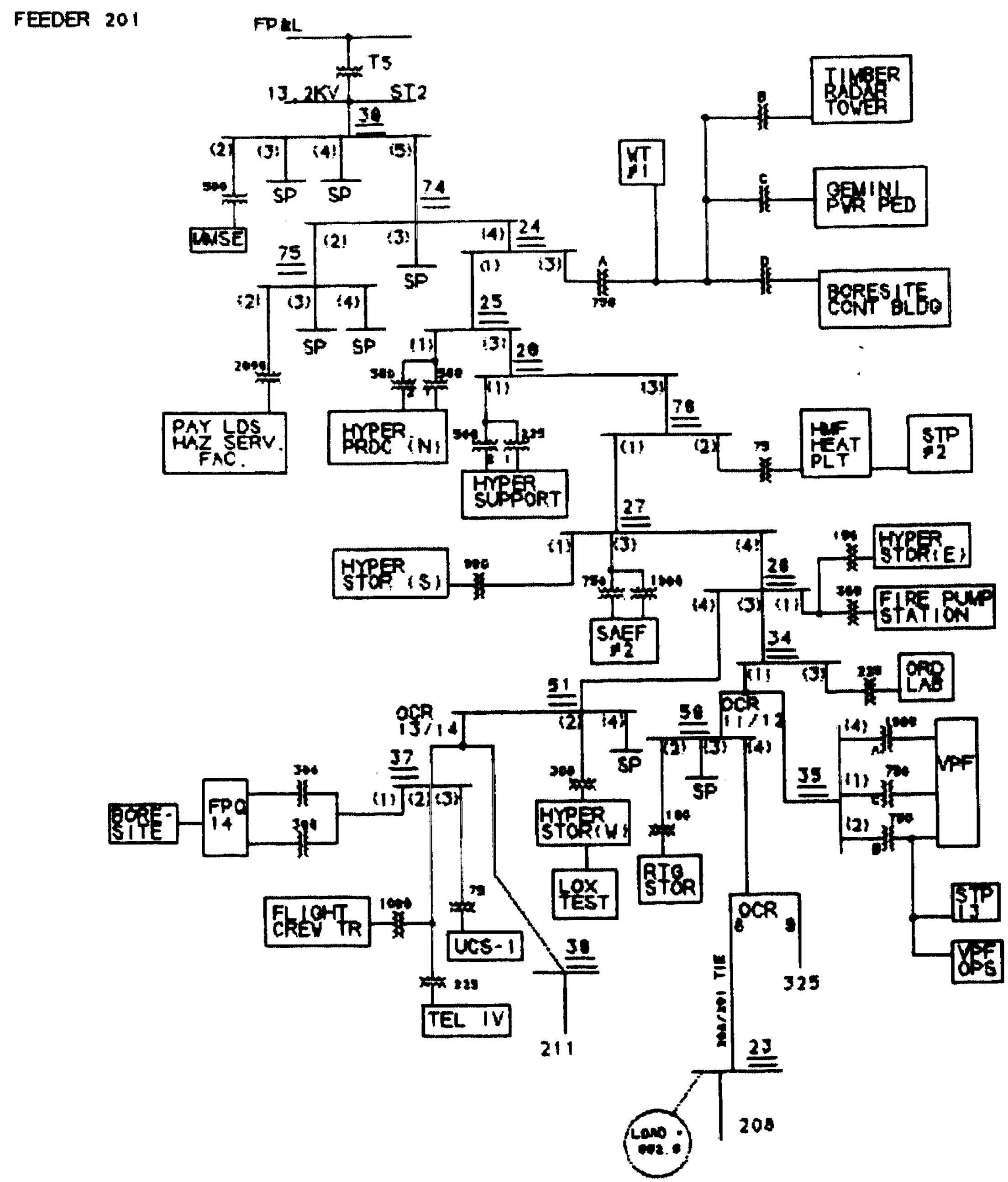
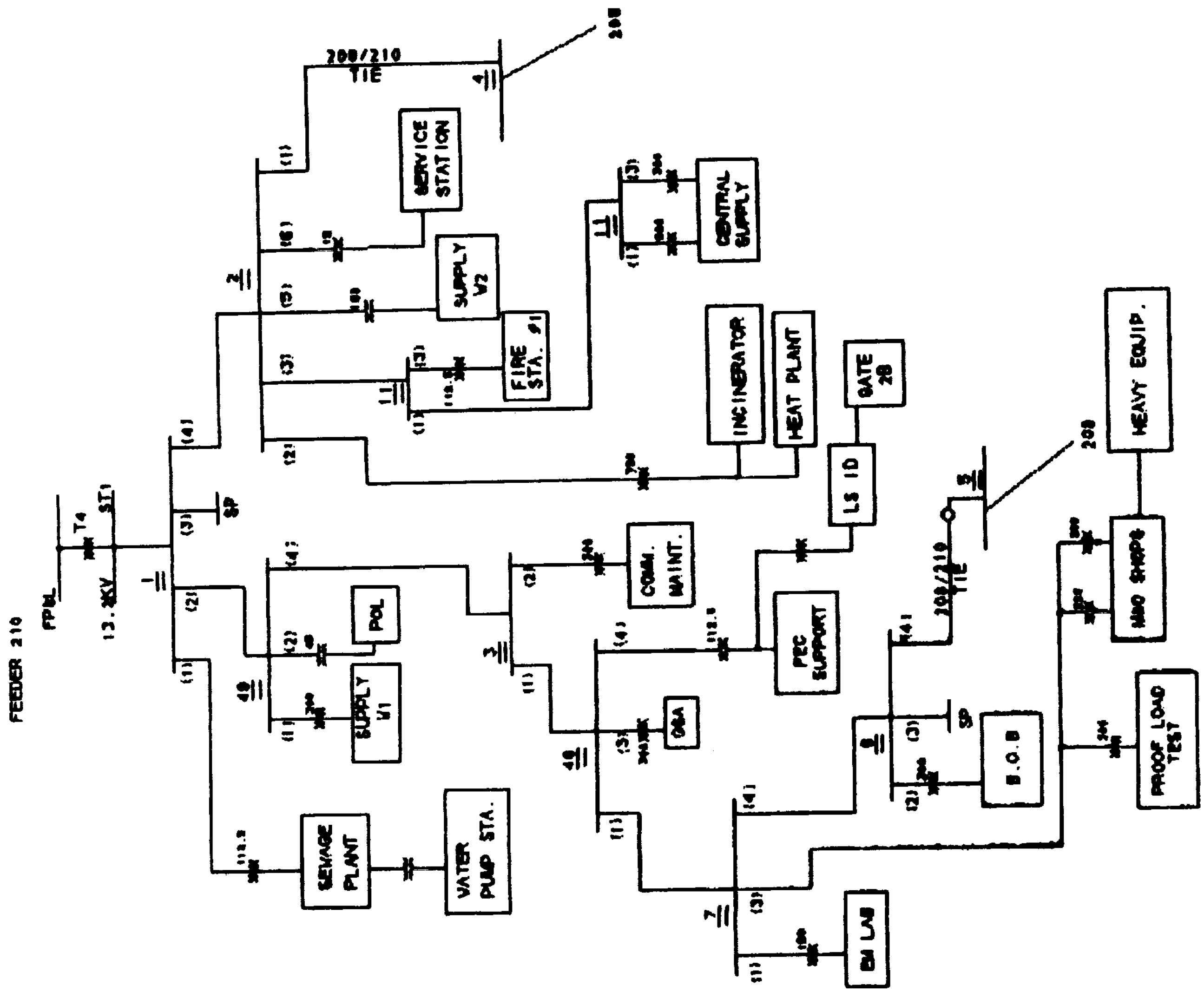
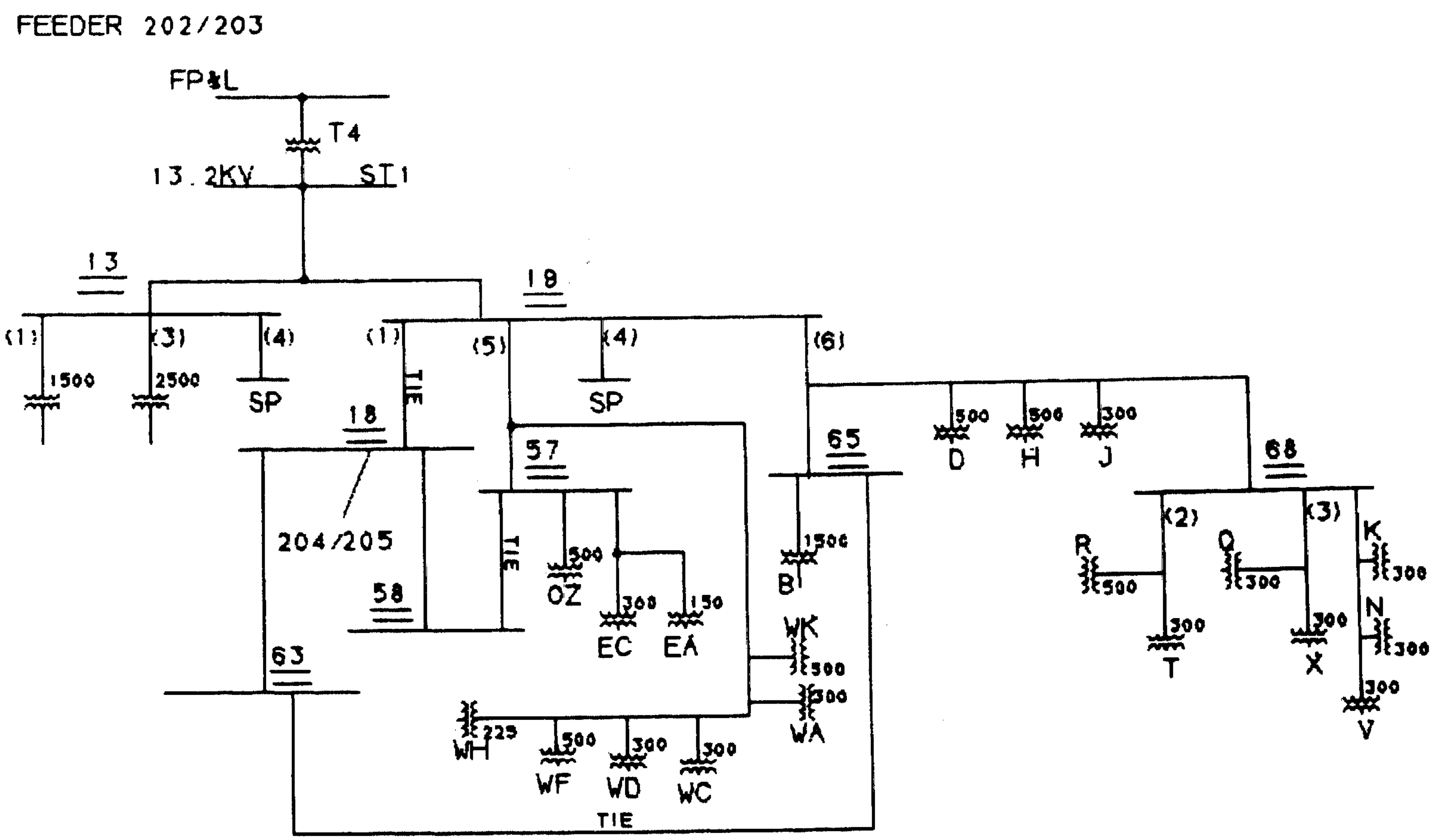

FEEDER 201
FP&L
T5
13.2KV
ST2
SP
WT #1
TIMBER RADAR TOWER
GEMINI PWR PED
BORESITE CONT BLDG
PAY LDS HAZ SERV. FAC.
HYPER PRDC (N)
HYPER SUPPORT
HMF HEAT PLT
STP #2
HYPER STOR (S)
SAEF #2
HYPER STOR (E)
FIRE PUMP STATION
ORD LAB
VPF
STP 13
VPF OPS
OCR 13/14
OCR 11/12
OCR
HYPER STOR (W)
LOX TEST
RTG STOR
BORE-SITE
FPQ 14
FLIGHT CREW TR
UCS-1
TEL IV
211
325
208

FIGURE 4



FEEDER 210
13.2KV
208/210
TIE
SERVICE STATION
SUPPLY V2
CENTRAL SUPPLY
FIRE STA. #1
INCINERATOR
HEAT PLANT
GATE 2B
LS ID
HEAVY EQUIP.
POL
SUPPLY V1
COMM. MAINT.
PEC SUPPORT
SEWAGE PLANT
WATER PUMP STA.
PROOF LOAD TEST
B.O.B
EM LAB

FIGURE 5



FEEDER 202/203
FP&L
T4
13.2KV
ST1
13
18
(1)
(3)
(4)
(5)
(6)
1500
2500
SP
TIE
18
204/205
58
63
57
OZ
EC
EA
65
B
WK
WA
WH
WF
WD
WC
D
H
J
68
(2)
R
Q
T
X
K
N
V
225
150
500
300

FIGURE 6

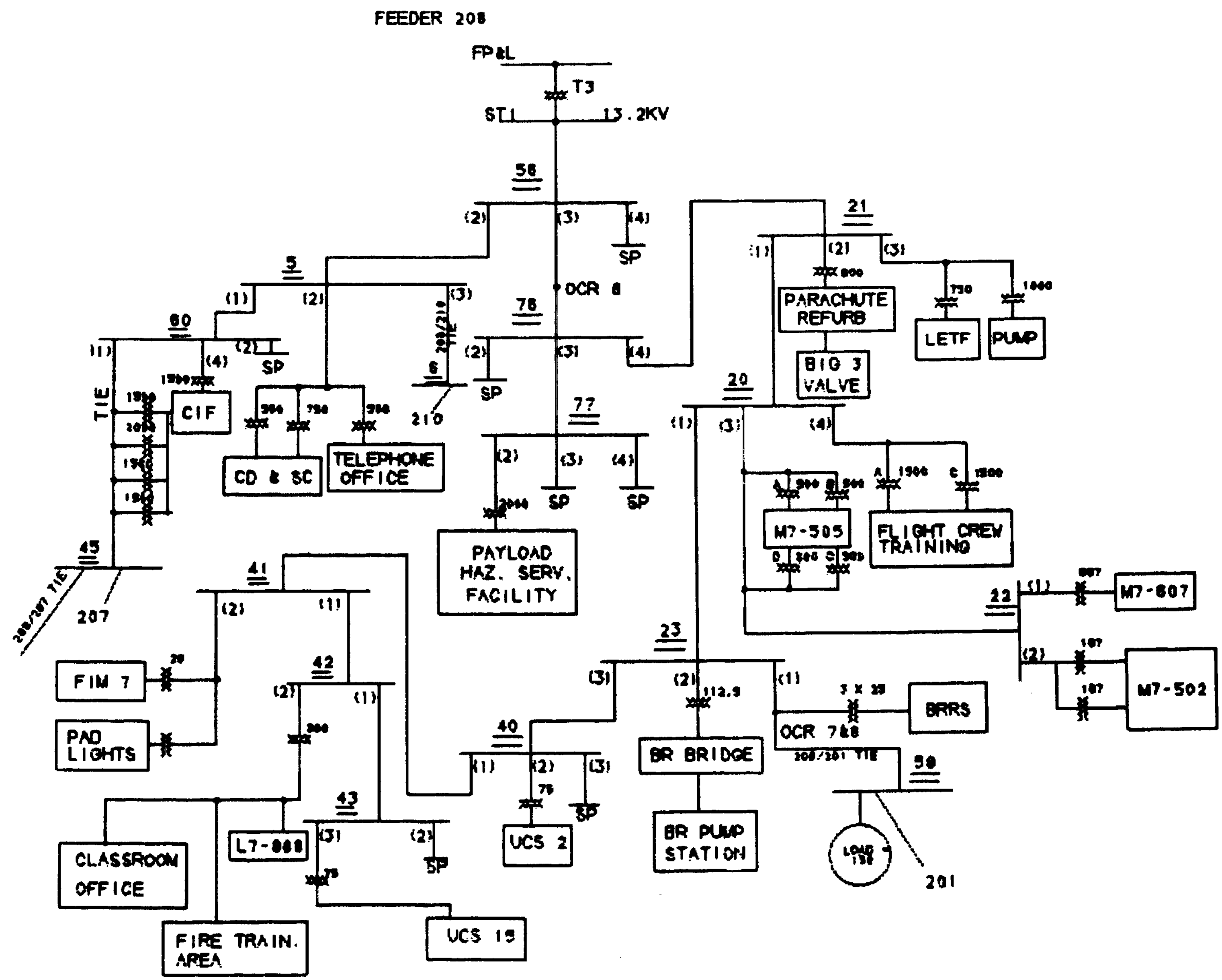

FEEDER 208
FP&L
T3
ST1
13.2KV
58
OCR 8
78
77
5
60
6
210
TIE
CIF
CD & SC
TELEPHONE OFFICE
PAYLOAD HAZ. SERV. FACILITY
45
207
41
42
43
40
FIM 7
PAD LIGHTS
CLASSROOM OFFICE
FIRE TRAIN. AREA
L7-888
UCS 15
UCS 2
21
PARACHUTE REFURB
BIG 3 VALVE
LETF
PUMP
20
M7-505
FLIGHT CREW TRAINING
22
M7-807
M7-502
23
BR BRIDGE
BR PUMP STATION
OCR 788
BRRS
58
201

FIGURE 7

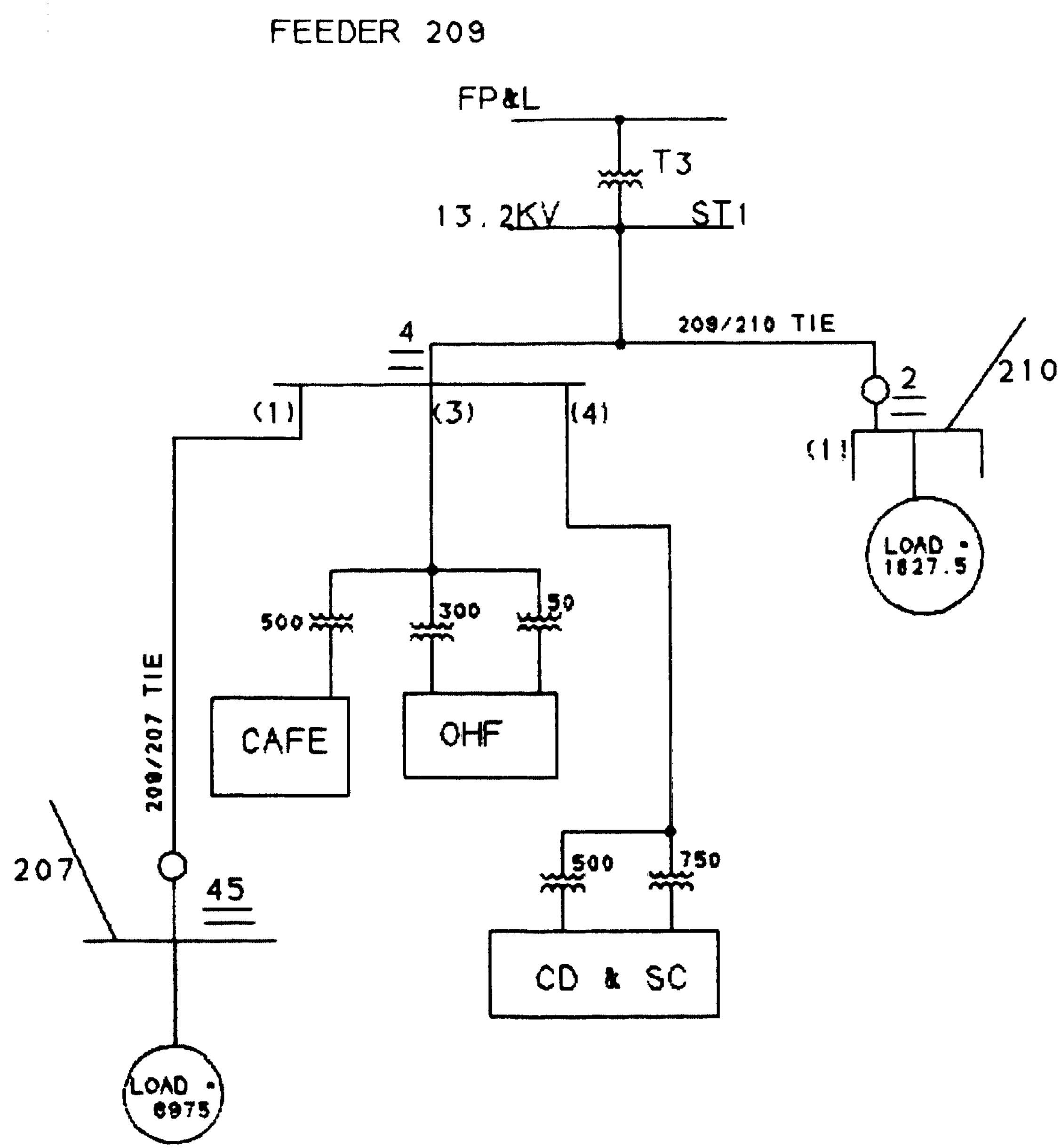

FEEDER 209
FP&L
T3
13.2KV
ST1
209/210 TIE
4
(1)
(3)
(4)
2
210
(1)
LOAD = 1827.5
500
300
50
CAFE
OHF
209/207 TIE
207
45
500
750
CD & SC
LOAD = 6975

FIGURE 8

FEEDER 103/212

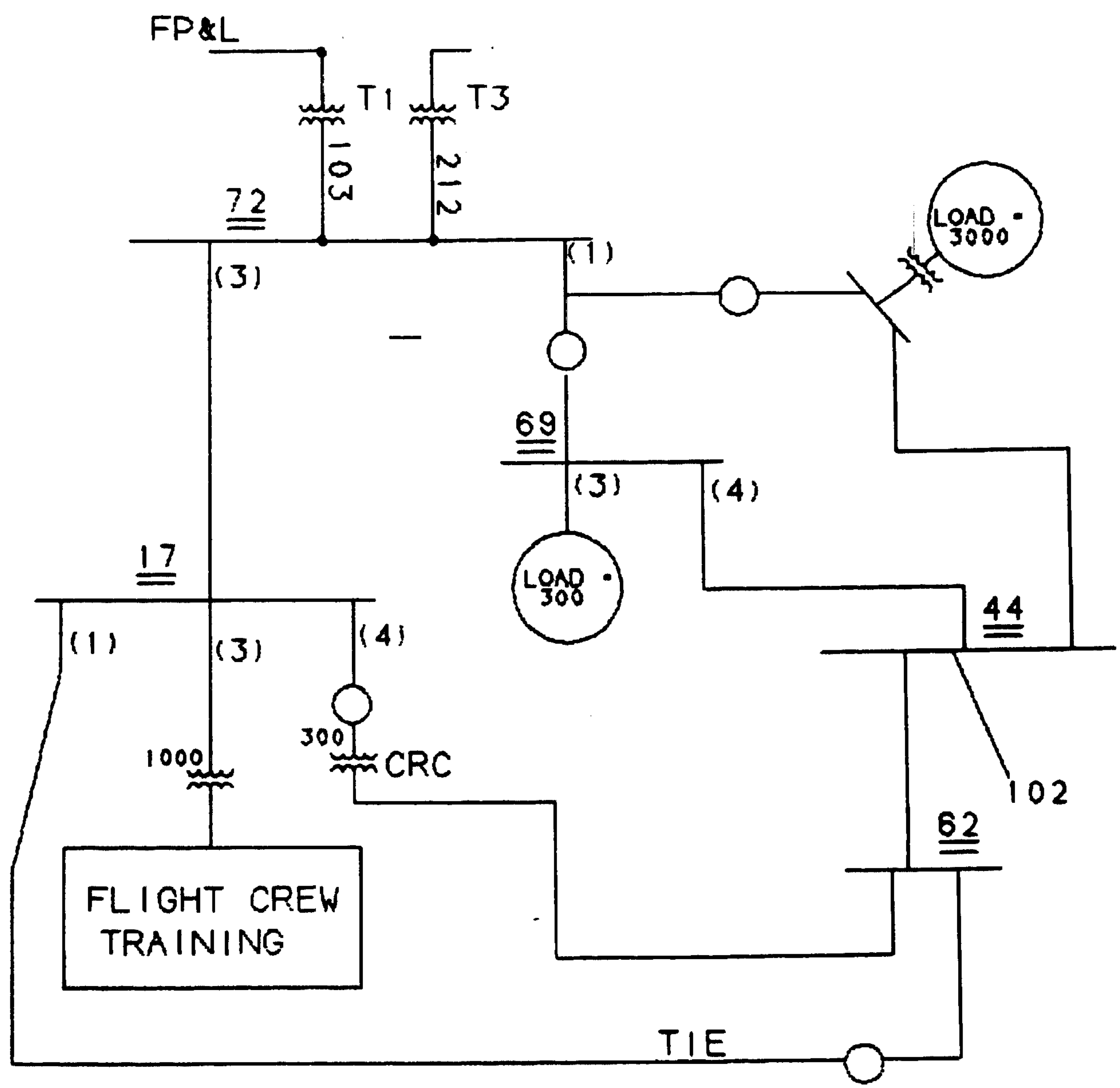
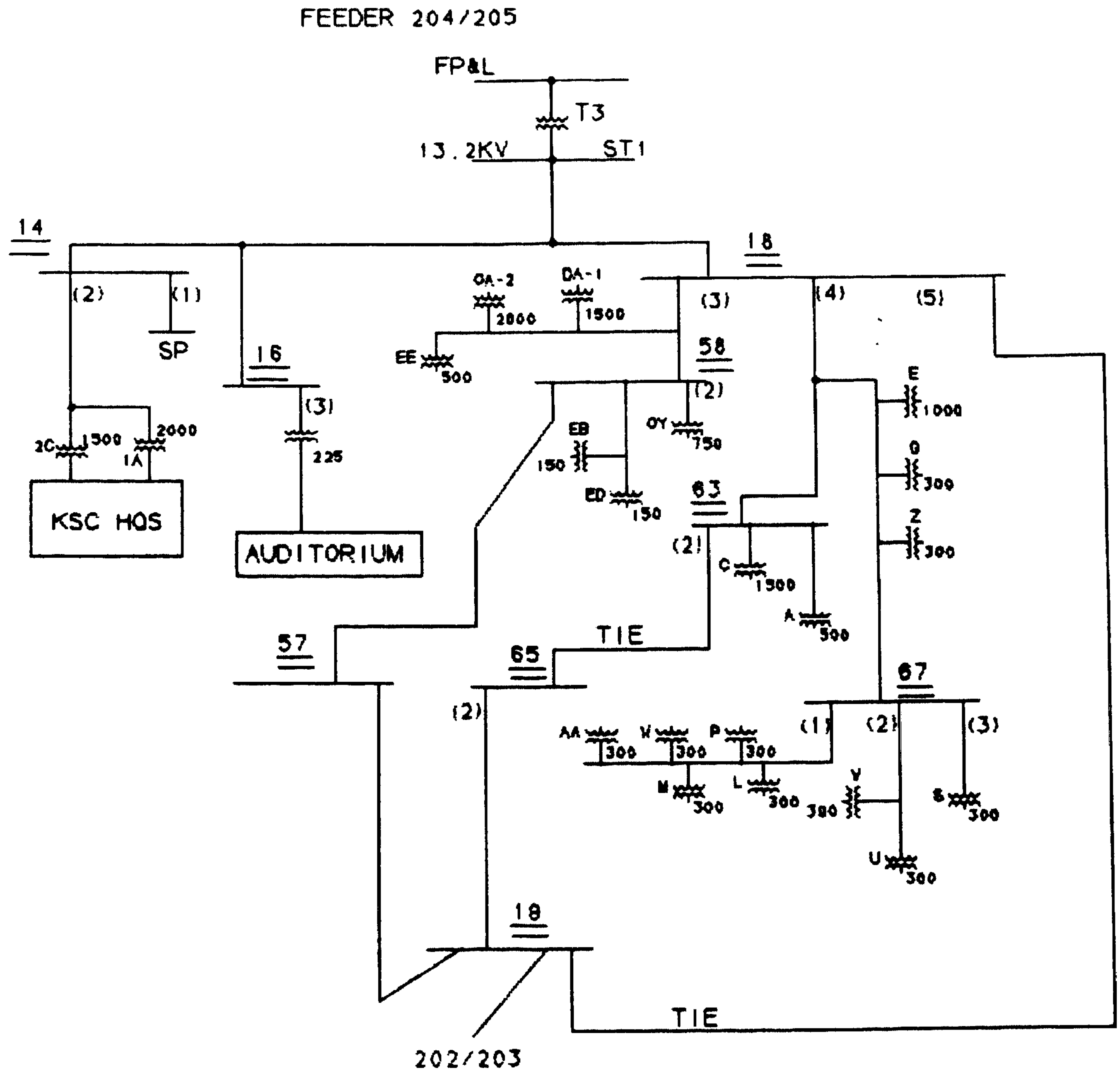


FIGURE 9



FEEDER 204/205
FP&L
T3
13.2KV
ST1
14
(2)
(1)
SP
2C
1500
2000
1A
KSC HOS
16
(3)
225
AUDITORIUM
OA-2
2000
OA-1
1500
EE
500
18
(3)
(4)
(5)
58
(2)
EB
150
OY
750
ED
150
63
(2)
C
1500
A
500
E
1000
G
300
Z
300
57
65
TIE
(2)
67
(1)
(2)
(3)
AA
300
W
300
P
300
M
300
L
300
V
300
S
300
U
300
18
TIE
202/203

FIGURE 10

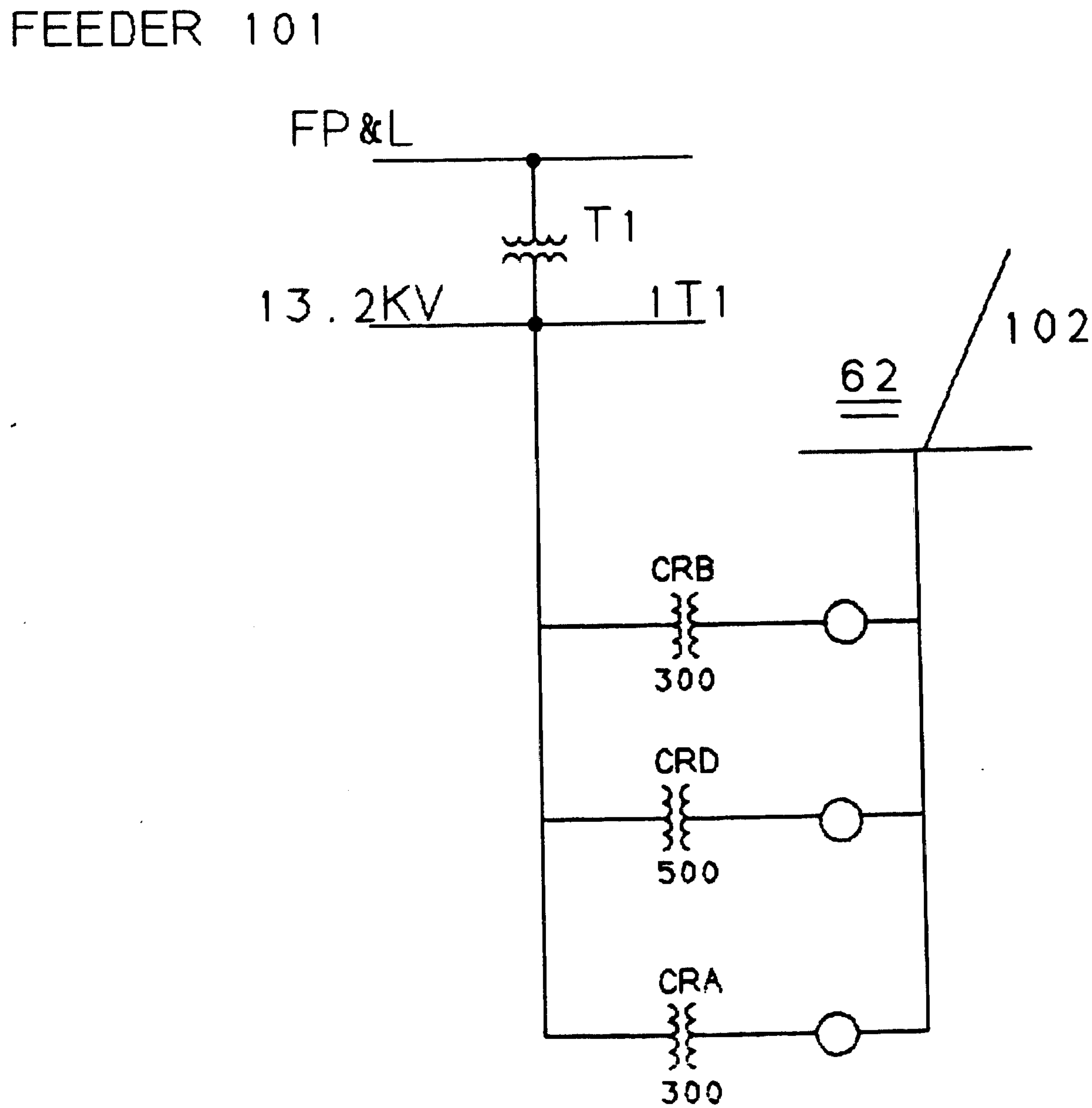
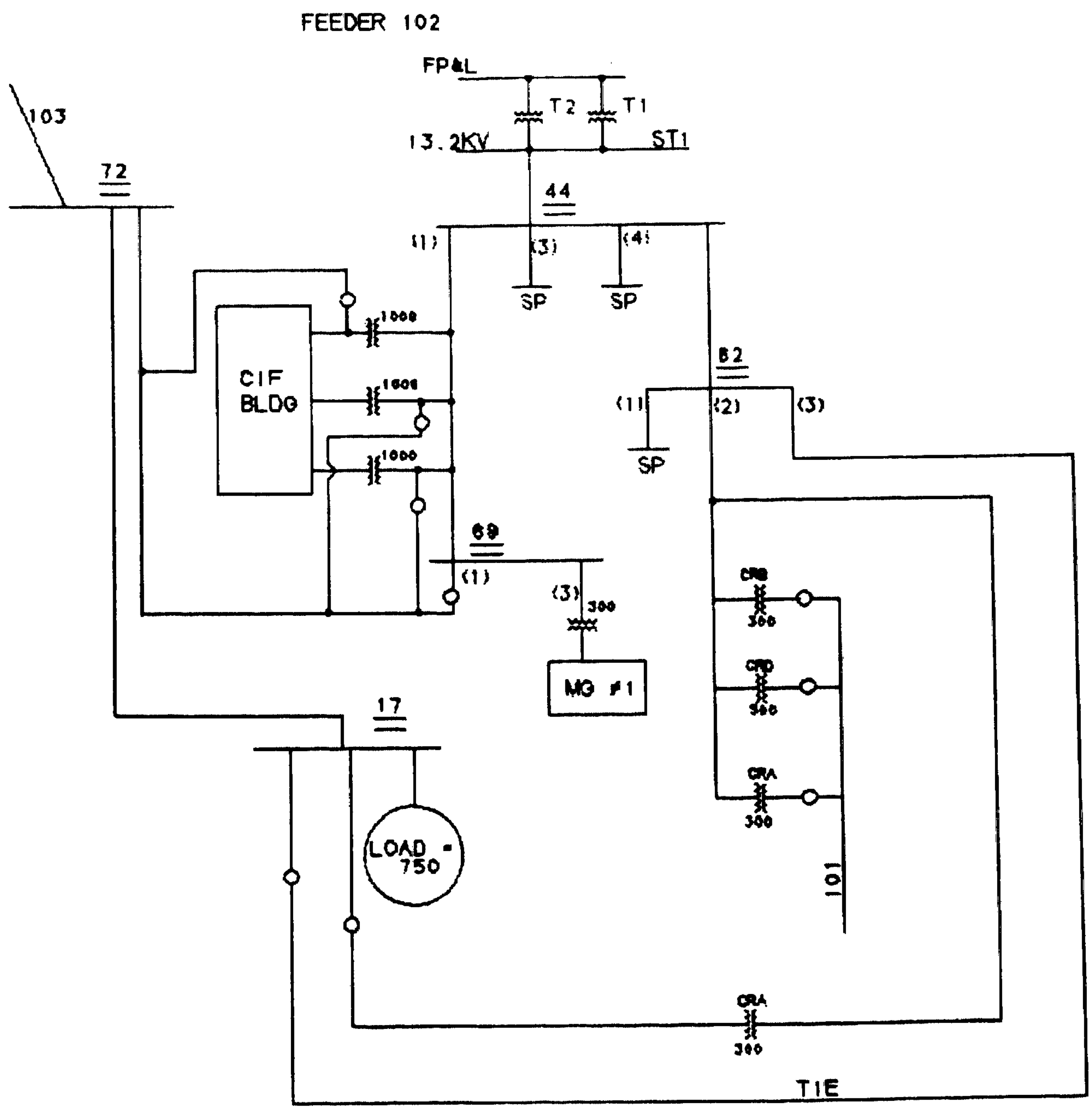


FIGURE 11



FEEDER 102
FP&L
T2
T1
13.2KV
ST1
103
72
44
(1)
(3)
(4)
SP
SP
CIF
BLDG
1000
1000
1000
B2
(1)
(2)
(3)
SP
69
(1)
(3)
300
MG #1
CRB
300
CRD
300
CRA
300
101
17
LOAD =
750
CRA
300
TIE

FIGURE 12

TABLE I

NORMAL CONFIGURATION LOADS ON THE LOAD BREAK SWITCHES AT THE ORSINO SUBSTATION

Lbs #	Supply Feeders	Adjacent LBS #s	Total Connected Load Under Normal Configuration	Added Load-if Failure Occurs Above LBS # - on Feeder	Special Features, Comments
	Feeder 206				
48	206 211 VIA LBS #47 609 VIA LBS #47	61, 47	15	Only single failures are considered. 112.5-61-206 612.5-OCR10-206	Tie point of 206 to 211 and 609
61	206	54, 58	127.5	500-OCR10-206	
55	206	54	2265		
15	206	54	2750		
54	206	T6,15, 55,61	5642.5		This is feeder 206.
	Feeder 211				
37	211 VIA OCR 14 201 VIA OCR 13	36,51	1900		This is a load bus. Connected load is shared by feeders 211 and 201.
36	211	10,37,51	15 1900[1]	300-51-201	Tie point of 211 to 201.
10	211	52,36	217.5	300-51-201	
52	211	9,10	480 1900[1]	300-51-201	
47	211,206,609 VIA REG	73,48,730		15-73-211 90-53-211 15-48-206 127.5-61-206 627.5-OCRIO-206 (C-5 not studied)	This is tie bus. 206/211 tie; and ORSINO/ C-5 tie.
73	211	53,47	15		

53	211	9.73	90		
9	211	T5,53, 52	570 1900[1]	300-51-201	This is feeder 211.
	<u>Feeder 207</u>				
60	207, 208 VIA LBS#5	45,5	1500	Only single failures are considered.	Tie bus for 207 to 208.
45	207, 209 VIA LBS#4	T5,60,4	7975	Only single failures are considered.	Tie point of 207 to 209. This is feeder 207.
	<u>Feeder 201</u>				
35	201	59,34	2500		Load bus end of 201
59	210 VIA OCR 12 208 VIA OCR 7	34,23,35	150, 2500[2] 325[3]	587.5-23-208 6388.5-20-208 8638.5-21-208 10638.5-76-208 ~~225-34-201~~	Tie bus., 201/208 tie
34	201, ~~208 VIA OCR 11~~	28,59,35	225 ~~2500[4]~~	150-59-208 ~~587.5-23-208~~ 6388.5-20-208 8638.5-21-208 10638.5-76-208	
37	201 VIA OCR 13 211 VIA OCR 14	51,36	1900		Load bus shared by feeders 201 and 211.
51	201, 211 VIA OCR 13	28,37,36	300 1900[5]	15-36-211 217.5-10-211 262.5-52-211	Tie point of 201 to 211
28	201	27,51,34	3475 1900[5] 150[6]	SEE LBS#59 SEE LBS#51	Failure above LBS#28 maybe assisted by 211 VIA LBS#36 or land by 208 VIA LBS#23.
27	201	78,28	5725, 1900[5] 150[6]	Same as for LBS#28.	Same as for LBS #28
78	201	26,27	5800 1900[5] 150[6]	Same as for LBS#27.	Same as for LBS #27

26	201	25,78	6525,78 1900[5] 150[6]	Same as for LBS#78.	Same as for LBS #78
25	201	24,26	7525 1990[5] 150[6]	Same as for LBS#26.	Same as for LBS #26
*24	201	74,25	8275 1900[5] 150[6]	Same as for LBS#25.	Same as for LBS#25
75	201	74	2000		
74	201	39,75,24	10275 1900[5] 150[6]	Same as for LBS#24.	Same as for LBS$24
39	201	T5,74	10775 1900[5] 150[6]	Same as for LBS#74.	This is feeder 201.
	Feeder 210				
6	210, 208 VIA LBS#5	7,5	300		Tie point of 210 to 208
7	210	46,6	1475		
46	210	3,7	1887.5		
3	210	49,7	2187.5		
49	210	1,3	2532.5		
12	210	11	800		
11	210	2,12	912.5		
2	210, 209 VIA LSB#4	1,11	1827.5	Only singlue failures are considered.	Tie point of 210 to 204
1	210	T4,2,49	4360		This is feeder 210
	Feeder 202/203				
68	202/203	19	2500		
65	202/203, 204/205 VIA LBS#63	19,63	1500	2000-63-204/205	

57	202/203, 204/205 VIA LBS#58	19,58	950	1050-58-204/205	
19	202/203, 204/205 VIA LBS#18	T4,57, 65.68,18	8175	7850-18-204/205	
13	202/203	T4	4000		
	Feeder 208				
43	208	42	75		Load Bus, end of 208
42	208	41,43	375		
41	208	40,42	400		
40	208	23,41	475		
23	208, 201 VIA OCR 8	20,40,59	587.5 325[7]	150-59-201 2650-OCR11-201 2875-34-201	Tie point of 208 to 201
22	208	20	1001		
20	208	21,22,23	6388.5 325[7]	Same as for LBS#23	
21	208	76,20	8638.5 325[7]	Same as for LBS#21	
77	208	76	2000		
76	208	56,77,21	10638.5 325[7]	Same as for LBS#21	
60	208, 207,209 VIA LBS#45	5,45	1500	Only single failures are conscicered	Tie point 208 to 207 VIA LBS#45. Failure abover LBS#60 on208 can be assisted by 207 and/or 209.
5	208, 210 VIA LBS #6	56,60, 6	1750	300-6-210 1475-7-210 1887.5-46-210 2187.5-3-210 2532.5-49-210	Failure above LBS#5 on 208 can be assisted by 210 VIA LBS#6 or by 207; 209 VIA LBS#45.

56	208	T3,5,76	11638.5 3257	SEE LBS#23, LBS#5	This is feeder 208.
	Feeder 209				
4	209, 210 VIA LBS#2 201 VIA LBS#45	T3,2,45	2100	6975-45-207 1827-5-2-210	This feeder is mostly a redundancy for feeders 210 and 207.
	Feeder 212/103				
17	103,212, 102 VIA LBS#62	72,62	1000	300-62-102	
72	103,212, 102 VIA LBS#69	T1,T3, 17,69	1000	300-62-102 300-69-102 3300-44-102	This is feeder 212 in parpallel with feeder 103.
	Feeder 204/205				
67	204/205	18	2400		
63	204/205, 202/203 VIA LBS#65	18,65	2000	1500-65-202/203	
58	204/205, 202/203 VIA LBS#57	18,57	1050	950-57-202/203	
18	204/205, 202/203 VIA LBS#19	T3,58 63,67,19	8750	8075-19-202/203	
16	204/205,	T3	225		
14	204/205	T3	3500		
	Feeder Total		12475		Feeder 204/205
	Feeder 101				
T1	101, 102 VIA LBS#62	62	1100	Only single failures are considered.	
	Feeder 102				
62	102, 103 VIA LBS#17	44,17	300	1100,101 750-17-103	

69	102, 103 VIA LBS #72	44,72	300	Only single failures are considered.
44	102	T1,T2, 69,62	3600	

IV RESULTS AND DISCUSSION

The information obtained from this investigation is presented in table 2 through 5. This can form the bases for a decision on where any additional load to the system can be made. Much of the information such as comparing demand to connected load are relevant only to the extent that it can help the system planning engineers to shape his/her engineering judgement. It is also important that the power coordinator pays attention to this data not necessarily to achieve higher system reliability, but to assure system optimal use and longivity.

To err on the side if safety, conservative assumptions are used to estimate quantities when there is no data to enforce precision. For instance, if a load is shared by two feeders, the shared load is added in full to compute the total load connected to each of the feeders. Also, since there is no demand data for the primary transformers the demands for the feeders connected to each primary transformer is added to estimate its demand as if those feeders peak simultaneously. Once more, it should be noted that all data are based on the system normal configuration and thus results obtained depict the worst case situations. The actual system reliability status is improved by the presence of redundancies and assist tie lines.

TABLE 2

CONNECTED LOAD -- DEMAND TABLE FOR FEEDERS

FDR	CONNECTED LOAD	DEMAND AUGUST 1988	MARGIN	DEMAND AUGUST 1989	MARGIN
206	5642.5	1750.60	3891.90		
211	570 1900[1]	976.97	1493.03		
207	7975	1188.55	6786.95		
201	10775 1900 [5] 150 [6]	2523.96	10301.04		
210	4360	1498.74	2861.26		
202/203	12175	4006.33	8168.67		
208	11638.5 325 [7]	2840.08	9123.42		
209	2100	853.54	1246.46		
212/103	1000	151.67	848.33		
204/205	12475	4417.27	8057.73		
101	1100	8.67	1091.33		

TABLE 3

CONNECTED LOAD -- DEMAND TABLE FOR PRIMARY TRANSFORMERS

T#	CONNECTED LOAD	DEMAND AUGUST 1988	MARGIN	DEMAND AUGUST 1989	MARGIN
T6	5642.5	1750.60	3891.90		
T5	21370	4689.48	16680.52		
T4	16535	5505.07	11029.93		
T3	27538.5	8117.02	19421.48		
T2+T1	5700	617.77	5082.23		

TABLE 4

PRIMARY TRANSFORMERS: SIZE VS CONNECTED LOAD

T#	SIZE	CONNECTED LOAD	MARGIN
T6	10000/12500	5642.5	4357.5
T5	10000/12500	21370	-11370
T4	10000/12500	16535	-6535
T3	10000/12500	27538.5	-17538.5
T1+T2	5000	5700	-700

TABLE 5

PRIMARY TRANSFORMERS: SIZE VS DEMAND TABLE

T#	SIZE	DEMAND AUGUST 1988	MARGIN	DEMAND AUGUST 1989	MARGIN
T6	10000/12500	1750.60	8249.40		
T5	10000/12500	4689.48	5310.52		
T4	10000/12500	5505.07	4494.93		
T3	10000/12500	8117.02	1882.98		
T1+T2	2500+2500	617.77	4382.23		

Orsino (Industrial Area) Substation Total Data:

Capacity = 45000 KVA

Connected Load = 76786 KVA

Capacity-Load Margin = - 31786 KVA

Demand: August 1988 = 20679.94 KVA

Capacity-Demand Margin = 24320.06 KVA

The above information showing demands (also in tables 3 and 5) is based on the assumption that peaks on all the feeders occur at the same time which is a very unlikely event. It is only used to estimate the worst case scenario. In fact, the system history reveal that no two feeder demands (Peaks) have ever occurred at the same time.

V CONCLUDING REMARKS

The data obtained during this study show that the industrial area (Orsino) Substation is healthy and reliable. There is a substantial margin between capacity and demand. History also does not show any need for additional protective devices or further redundancies.

However, the data reveals that loads have been added arbitrarily or perhaps based on geographic convenience (or associated costs) only, during growth. This philosophy does not lead to optimal system performance. The reduction or even elimination of outages should not be the only concern in power system operation. Well coordinated power and proper load distribution enhance several good results. The information such as contained in this report should be useful for making such decisions.

It will be desirable if a similar study is performed on the C-5 substation and thus on the entire 60-HZ power system. This could form the basis for a formal power systems planning here at K.S.C. This is needed in a rapidly growing facility such as K.S.C. With anticipated ever growing load, arbitrariness may lead to very poor results.

The initial intentions of this researcher was to do a classical load flow analysis and reliability analysis on the 60-HZ power system at K.S.C. The system which was constructed over twenty five years ago has undergone a lot of growth. Numerous load break switches have been added resulting in a new configuration. The diagrams shown in this report are based on the present system configuration.

However, data on the present form, such as the impedances of the lines from bus to bus are still being constructed. This made it impossible to perform a classical power flow analysis on the system. Further, the contractor, EG&G, that operates the system recently acquired a new package EDSA which is capable of performing such an analysis. Also, lacking at present is a complete inventory of component reliability parameters such as failure rates and repair rates. These are essential inputs for a classical system reliability analysis. These classical studies could not be performed at this time for the above reasons.

With the system being as healthy and reliable as it is; the capacity - demand margin being very substantial and history showing no reason for immediate concern. Attention can be sshifted to the effects of future growth. None the less, the author would still suggest that meter readings be taken at the Primary transformer levels and isolation devices be placed above several load break switches.

REFERENCES

1. GP-900 Revision A - 60 Hz Power Systems Integrated Plan - Prepared by Planning Research Corporation Systems Services Company, May 1983.

2. 79K17429 - KSC Power Distribution One-line Diagram - Prepared by EG&G Florida, September 1987.